North Pacific Fishery Management Council

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2006 Research Priorities

In assembling this list of research priorities, the SSC has focused on five broad themes: Stock Assessment, Stock Surveys, Ecosystem Studies, Social and Economic Data and Analyses, and Fishery Performance and Monitoring. In keeping with past practice, we have provided an extensive, but not exhaustive, list of critical gaps in data and analysis that would inform Council decision-making. It is not anticipated that all of these research priorities can be addressed in the upcoming year or that they could be addressed with funding from a single source. Instead, the SSC anticipates that state and federal agencies, universities, and foundations will consider this list in the context of their unique research missions and that these entities will incorporate elements of this list that overlap with their specific areas of interest and stewardship. In a departure from previous practice, we have highlighted a group of particularly timely or pressing research priorities within each of the broad themes; these highlighted research priorities represent gaps in data and analysis that we consider to be particularly important for addressing current or emerging management issues.

A. Critical Assessment Problems

The SSC notes that continued research on the life history of groundfish, crab and scallop should be considered an essential activity to improve stock assessments and management of managed resources. The SSC encourages research by academic and governmental agencies to collect this information. Critical life history research topics include: estimates of natural mortality (including temporal shifts in predation for target species), size-at-maturity or age-at-maturity (including environmental factors influencing maturity schedules), maternal effects (especially for Pacific cod and long-lived species such as rockfish), environmental impacts on growth, and environmental factors influencing reproductive success. The following lists identify high priority research for groundfish, crab and scallops.

Groundfish (GPT number corresponds to the November 2005 plan team list)

1. Rockfish – a general need for improved fishery independent estimates of abundance, catch, stock structure, and biological variables. (GPT A3)

   a. Supplemental trawl survey biomass estimates to address patchy distribution (also see section B).

   b. Age samples from the fishery, esp. POP, northern rockfish, and dusky rockfish. There is a need to increase the number of age determinations annually conducted for rockfish and to train researchers to make age determinations on species that are difficult to age.

2. Improved stock assessment of "other species." Items a through f below come from the Plan Teams, although item d has been revised by the SSC. The SSC ranks items a, d, and e very high because they form the basis for a tier 5 calculation. (GPT A2)

   a. Improved identification of priority species within each group in the fisheries by both processors and observers to avoid misidentifications, as well as categories containing large numbers of unidentified species.

b. Species-specific identification of priority species on scientific surveys, including NMFS trawl and longline surveys, IPHC surveys, and ADF&G surveys.

c. Improved biological data collection via enhanced survey sampling, fishery port sampling and at-sea observations, including collection of lengths and age structures for priority species.

d. Alternative indices of abundance (and biomass) and fishing mortality are necessary for species for which standard surveys are inadequate. With an increase in the number needed stock assessments, it will be critical to develop alternative estimates of abundance and/or direct estimates of fishing mortality. Two possibilities that require dedicated research for development are: (1) directly estimate fishing mortalities through large-scale tagging programs, and (2) habitat-based estimates of abundance based on local density estimates in combination with large-scale habitat maps.

e. Life history information (specifically, natural mortality, size at maturity, and other basic indicators of stock production) must be improved for many members of the others species complex to allow application of Tier 5 or Tier 4 assessment criteria. Little information is available especially for sculpins, skates, octopuses, squids, grenadiers and some sharks.

f. Improved catch histories for groups in this complex for improved stock assessment and application of Tier 6 criteria. Greater use of historical foreign observer data is needed, as part of this activity.

3. Research is needed to incorporate seasonal movements, and stock boundaries of managed species into stock assessments. Expanded genetic research is needed to identify stock boundaries. Expanded tagging efforts are needed to support the development of spatially explicit assessments. High priority species for spatially explicit models include: walleye pollock, Pacific cod, sablefish, yellowfin sole, rock sole, Pacific ocean perch, and Atka mackerel,. (GPT A13, modified from GPT A6c)

4. Incorporating uncertainty into the stock assessment advice. This requirement was proposed in the PSEIS, but progress towards amending the groundfish guidelines to address this issue has not been started. Management strategy evaluations are also encouraged because these evaluations serve as useful tools to assess the efficacy of harvest control measures under different assumptions regarding stock production. (GPT A15).

5. Efforts to incorporate ecosystem considerations into stock assessments should be accelerated through research to improve knowledge of the functional relationship between environmental factors (e.g. physics, competition, and predation) and recruitment, growth, natural mortality and availability to surveys. (GPT C1)

Crabs

1. Natural mortality (M) estimates. Estimates of M (obtained independently from models) are needed for all stocks (except Bristol Bay red king crab), with highest priority assigned to Tanner and snow crabs. (ADF&G overall priorities (1), ADF&G Stock Productivity (1-9), AFSC (8).

2. Conduct field studies to improve knowledge of growth increments and the relationship between shell condition and age of Bering Sea Tanner and snow crabs. (ADF&G overall priorities 2, ADF&G Growth (14), AFSC (4).

3. Improve understanding of seasonal movements and natural mortality of crabs through mark recapture studies (ADF&G overall priorities (2), ADF&G Stock Structure (6), ADF&G Stock Productivity (1) and AFSC (1)).

4. Improve understanding of processes influencing the fertilization rate of egg clutches, including consideration of spatial dynamics of crab reproduction and contribution to reproduction by males as a function of size and time post molt. Primary emphasis is on snow and Tanner crabs, with secondary emphasis on red king crab. (ADF&G overall priorities 3, ADF&G Reproduction (18 - 24), AFSC (3, 15 and 16)

5. Conduct studies to improve crab aging using radiometric aging or lipofuscin. ADF&G Growth (10, 12, 16), AFSC (2, 10 and 12).

6. Improve understanding of processes controlling recruitment dynamics for all FMP crab species. Incorporate these processes into scenarios regarding temporal trends in recruitment. Perform a management strategy evaluation using variable recruitment scenarios. This is a very broad topic encompassing the need to identify and assess biological and environmental effects on egg production, egg hatching, and larval survival, as well as mechanisms controlling the abundance of juvenile crabs from settlement to recruitment into the fishery. Factors include larval transport, predation, competition, and habitat availability. Primary emphasis is on stocks currently declared overfished: eastern Bering Sea Tanner crab, St. Matthew Island blue king crab, eastern Bering Sea snow crab, and Pribilof Islands blue king crab. (ADF&G Settlement and Recruitment (25, 30), AFSC (18))

Scallops

1. Development of an age-structured model for assessment of abundance to be applied to each stock (e.g., Yakutat, Prince William Sound, Cook Inlet, and so forth).

2. Identify larval sources, as well as advective pathways, to evaluate the potential effects of fishing on recruitment for major beds.

3. Estimate survival rates for discarded scallops and of scallops that are encountered but pass through the dredge rings.

4. Investigate causes of high natural mortality recently observed in the Cook Inlet fishery, and of the "weak shell" syndrome observed in the Yakutat area.

B. Stock Survey Concerns

The SSC notes that continuation of annual or biennial surveys in the GOA, AI and EBS are a critical aspect of natural resource management. These surveys provide baseline distribution and abundance data that form the foundation for stock assessments and the development of ecosystem approaches to management. These surveys should be considered a high priority research activity.

Groundfish (GPT number corresponds to the November 2005 plan team list)

1. Direct observations (e.g., submersible and dive surveys) to compare fish densities, particularly for rockfish, between trawlable and nontrawlable habitats. (GPT B5 and B9).

2. Increase knowledge of the acoustic sign types and target strength to length relationships to allow assessment of other targets during hydroacoustic surveys. (GPT B12).

3. Expand surveys beyond typical boundaries to include the shelf break and the northern Bering Sea to evaluate the fraction of the stocks that are not assessed by the shelf survey. (GPT B3).

4. Improved surveys for minor rockfish species to verify range relative to standard surveys.

5. Expand the collection of underway oceanographic data and marine mammal sighting during standard assessment surveys (see C4).

Crabs (Source noted in parentheses)

1. Conduct calibration studies to assess survey selectivity and catchability of snow crab, Tanner crab, and blue king crab with current trawl survey gear and new survey net. ADF&G over all priorities (4), ADF&G (5 &6), and AFSC (5 and 6).

Scallops (SPT number corresponds to numbered list in Appendix E of Scallop FMP)

1. Expansion of the recently developed remote video survey method for two objectives:
   a. To estimate densities and abundance in major fishing areas as well as in nearby unfished areas (to monitor environmental effects independent of fishing), and
   b. To estimate catchability coefficients for commercial and research dredges.

C. Expanded Ecosystem Studies
In developing a "short list" of priority research questions for ecosystem studies, we had to select from a large number of valuable research questions brought forward by the Plan Teams. The research priorities brought forward by the SSC were seen as potentially having impact on management decisions. (For reference the GPT number corresponds to the November 2005 Groundfish Plan Team list.)

1. Habitat mapping. Improved habitat maps are required to identify essential fish habitat and to support habitat-based models of distribution and abundance. Such models have great potential to lead to improved estimates of stock size and will help resolve the spatial structure of stocks and ecosystems. (This includes current research topic GPT C12). Especially for demersal fishes and shellfish, the distribution of habitat types may interact with changes in water column characteristics, such as temperature, to constrain future distributions and abundances of these species.

2. Forage fish. Understanding the dynamics of important pelagic and benthic forage species, such as capelin, herring, myctophids, euphausiids, shrimp, squid, and juvenile pollock remains a high priority for understanding energy flow to commercially important species and to protected species, including seabirds and mammals. Innovative approaches to assessing such stocks are needed and may include novel acoustic techniques (e.g. low-frequency sound), air-borne surveys, and indices based on the diet of predators, including seabirds or marine mammals. (Current research topic GPT C6 and item (3) under GPT C8).

3. Ecological effects of bycatch and discards. Selective removal of certain species of certain size ranges can affect the relative abundance of fish communities, perhaps with consequences on their ecological interactions. Moreover, fishery discards can favor scavenging species over others, perhaps with consequences on groups, such as seabirds and benthic communities.

4. Climate change and fish communities. If recent changes in ice cover and temperatures in the Bering Sea persist, they may have profound effects on marine communities. Existing data sets (bottom trawl surveys, BASIS surveys) can be used to quantify changes in relative species composition of commercial and non-commercial species, identify and map assemblages, and monitor changes in the distribution of individual species and assemblages. (GPT C18, as well as GPT C9)

5. Environmental effects on recruitment and growth. Studies on effects of climate on recruitment and growth (GPT C1) could include the development of standard environmental

scenarios for future variability based on observed patterns (GPT C2). There is also a clear need for information that covers a wider range of seasons than presently available (GPT C8).

6. <u>Nutrients and lower trophic levels.</u> There is limited information regarding nutrient dynamics and phytoplankton/zooplankton dynamics on the Bering Sea and Gulf of Alaska shelves (e.g., supply of nutrients to the shelf, interannual variability and changes in nutrient supply, potential for HABs, etc.). Recent advances in technology such as towed undulating vehicles with various sensors and plankton recorders allow high-frequency sampling of both nutrients and plankton. Such sampling could support detailed process studies as well as the development of relatively low-cost monitoring programs in conjunction with existing surveys or through new surveys. (Some of GPT C3).

7. <u>Advancing ecosystem approach to fisheries management.</u> This includes development of suitable indicators and indicator species (including novel approaches such as using corticosterone levels in predators as an indicator of prey availability (GPT C20), developing ecosystem reference points, including OY cap considerations (CPT C11), and improvements of current ecosystem models (GPT C8). Standardization of "future scenarios" (GPT C2) will help to promote comparability of model outputs. Process-oriented research focused on local impacts of fishing on prey availability for top trophic level consumers will also be informative.

D. Social and economic research

The need for the development and continued maintenance of basic social and economic information databases on the fisheries and fisheries dependent communities of GOA and BSAI is made ever more pressing as the Council continues to adopt actions that are intended to improve the long term net benefits derived from fisheries. This information is required for establishing a baseline to be used in identifying stakeholders to be included in the distribution of dedicated access privileges (e.g., harvesting quotas and processing quotas), a baseline to be used for projecting the likely consequences of alternative management measures, and as a baseline for retrospective analysis of management actions that have been taken.

Particularly pressing research needs include:

1. Development of an ongoing database of product inventories (and trade volume and prices) for principal shellfish, groundfish, and salmon harvested by US fisheries in the North Pacific and Eastern Bering Sea.

2. Analyses of current determinants of exvessel, wholesale, international, and retail demands for principal seafood products from the GOA and BSAI;

3. Pre- and post-implementation studies of the benefits and costs, and distribution of benefits and costs associated with changes in management regimes (e.g., changes in product markets, characteristics of quota share markets, changes in distribution of ownership, changes in crew compensation, as a consequence of the introduction of dedicated access privileges in the halibut/sablefish, pollock, and crab fisheries). "Benefits and costs" include both economic and social dimensions.

4. Prospective analyses of the robustness and resilience of alternative management strategies under varying environmental and ecological conditions; and,

5. Prospective and retrospective analyses of changes in the spatial and temporal distribution of fishing effort in response to management actions (e.g., time/area closures, marine reserves, bycatch restrictions, co-ops, IFQs).

Kodiak is at the center of controversy associated with the recently adopted crab rationalization program. What were the direct and indirect impacts and how were the impacts distributed throughout the community? As Kodiak is also likely to be at the center of controversy over the likely consequences of Gulf rationalization, it would be particularly advantageous if research could be designed to use Kodiak or other Gulf communities as case studies in analyses of the effects.

Additional important research needs include:

1. Development of longitudinal data sets of:

    a. Transaction level observations of exvessel, wholesale, and retail prices;

    b. Daily or weekly, firm-scale data on production by species and product form;

    c. Trip-scale data on variable costs (e.g., fuel, labor, supplies, etc.) for catcher vessels, catcher-processors, and sportfishing charters (this data should be matched with existing data on catch, catch composition, and production);

    d. Daily or weekly plant-scale data on variable processing costs (e.g., fuel and power, labor, supplies, packaging, etc.) for shore-based and floating processors;

    e. Annual vessel- or plant-level data on fixed costs (e.g., capital replacement, maintenance, repair, upgrades, insurance, etc.);

    f. Trip-scale information about the location and duration of fishing (e.g., VMS records, or observer information on steaming time, fishing time, etc.);

    g. Weekly or monthly data on patterns (location and magnitude) of expenditures associated with harvesting, processing, and sportfishing charters;

    h. Pay-period scale, vessel- and plant-level data on employment and income of fishery participants, especially crew and processing plant workers;

    i. Socioeconomic and demographic data for fishery dependent communities (income levels and distributions, population levels and distributions); and,

    j. Community- and regional-scale annual data on the distribution and magnitude of tax receipts and transfer payments associated with commercial and sport fishing.

2. Analyses or the development of models to evaluate:

    a. The evolution of community social and economic structure in response to alternative management actions:

        i. Baseline assessments of selected communities and industry sectors relative to social considerations identified by the Council and the Advisory Panel;

        ii. Field studies to elucidate the full array of linkages between fisheries and social and economic life in fishery dependent communities;

        iii. Regional economic models of activities and impacts associated with commercial, sport and subsistence fisheries;

        iv. Prospective and retrospective studies of the social and economic impacts of alternative management actions;

        v. Development of better methods for determining the social costs and benefits of management actions (e.g. through the use of non-market valuation techniques);

    b. The benefits, costs, and the distribution of benefits and costs associated with consumptive and non-consumptive uses of resources supported by the North Pacific and Eastern Bering Sea ecosystems:

        i. Cost functions for harvesting, processing, and sportfishing charters;

        ii. Producers and consumers surpluses associated with commercial fisheries under current and alternative management regimes;

iii. The magnitude and distribution of benefits and costs associated with sport and subsistence harvests under current and alternative management regimes;

iv. Existence and option values associated with corals, seabirds, and marine mammals;

v. The value of ecosystem services;

c. Evaluation of alternative management strategies:

i. The cumulative efficiency and equity consequences of management actions that apply time/area closures;

ii. Management strategies and optimal yield for multi-use fisheries, e.g., commercial, sport, and subsistence fisheries for halibut and salmon;

iii. The relationship between sampling strategies and the confidence of bycatch estimates associated with individual and pooled bycatch quotas and the economic and social costs of bycatch;

iv. Changes in catch efficiency and operating costs associated with gear modification and avoidance behaviors intended to reduce bycatch;

d. Evolving seafood markets:

i. Mechanisms for providing and costs of traceability systems for certifying product and production process attributes of seafoods;

ii. Consumer demand for seafood ands its associated byproducts harvested from stocks that have been certified as sustainably managed.

E. Fishery Performance and Monitoring
The Groundfish Plan Team brought forward an expanded set of research needs to address bycatch and fishery monitoring (Sections E and F from the Groundfish Plan Team's November 2005 list). The SSC saw commonality among needs to describe bycatch and fishery catch, and developed the following merged set of top priorities for fishery performance and monitoring.

1. Improved onboard observations. Improvements in at-sea observations are needed in several areas:

a. Observer deployment and coverage. There is a long-standing need to review the allocation of observers among fisheries to adequately characterize the total catch, as well as a review of sampling procedures (e.g., basket versus whole haul) employed by observers that form the basis for total catch estimation.

b. At present, it is clear that observer coverage in some fisheries is insufficient for estimation of total bycatch. Examples include the sablefish longline fishery, skate fishery, Pacific cod pot and longline fishery, and halibut longline fishery. This results in imprecise bycatch estimates for species, such as skates, sharks, yelloweye rockfish, and sablefish in halibut fisheries.

c. Conduct research on mechanisms to supplement observer program information. Improved means of data collection are needed, especially on small vessels. Research is needed on utility of other data collection methods, such as at-sea video monitoring, port sampling, and other direct methods.

d. Improved biological data collection. There are needs to improve biological data collection (e.g., age, size, sex) of some bycatch species (e.g., sharks, skates, octopus, squid, sculpins, grenadiers) to better quantify potential effects of bycatch on these stocks. Better estimates of stock of origin are needed for salmon bycatch.

2. <u>Research on discard mortality rates.</u> Better estimates of discard mortality rates by gear and fishery is needed to estimate more accurately total bycatch mortality for all discarded species, with an emphasis on such species as crabs, skates, sharks, rays, and octopus.

3. <u>Improved estimation methods for total catch (including bycatch) and fishing mortality of all target and non-target species.</u> Two levels of improvements are needed:

    a. <u>Improved estimation at the stock and fishery level.</u> Assessment and management depend critically on catch estimates. More rigorous statistical methods for catch estimation need to be implemented (e.g., Miller 2005). Specifically, identifying sources of variability in actual and estimated bycatch rates is needed. Approaches to integrate estimates of variance on the observed portion of the fisheries into the total catch estimates are needed.

    b. <u>Improved detailed estimation of catch for specific management programs.</u> Some management programs (e.g., IFQ, cooperatives, other rationalization programs) require extensive record keeping to increasingly finer degrees of resolution (e.g., vessel, subareas). Research is needed to evaluate the effectiveness of reporting systems to newly developed management groups or practices.

4. <u>Efficacy of bycatch mitigation measures.</u> Research is needed on the efficacy of bycatch mitigation measures (e.g., PSCs, time/area closures) and their effects on populations of the bycatch and target species, effects of changes in abundance of bycatch species on bycatch rates, and methods for assessing the economic and social costs of bycatch.

5. <u>Gear technology.</u> Further research is needed on gear modifications for reducing bycatch, such as research that has been conducted to protect salmon, halibut, rockfish and seabirds.